CARD 1 / 2 PA - 1989

JBJECT USSR / PHYSICS
AUTHOR SOBOLEV,V.V.
TITLE ~~The Transport~~ of Radiation in an Inhomogeneous Medium.
PERIODICAL Dokl.Akad.Nauk 111, fasc.5, 1000-1003 (1956)
Issued: 1 / 1957

The present work investigates a special case of the problem mentioned above, viz. the determination of the luminescence of a semi-infinite medium consisting of plane-parallel plates in the case of a spherical indicatrix of scattering. The ratio between the scattering coefficient and the sum of the coefficients of scattering and true absorption (i.e. the probability of the survival of the quantum on the occasion of the elementary act of scattering) is here denoted by λ , and this quantity is looked upon as a function of the optic depth τ.

This problem is reduced to the solution of the following integral equation:

$$B(\tau) = \frac{\lambda(\tau)}{2} \int_0^\infty B(\tau') \, Ei \, |\tau - \tau'| \, d\tau' + g(\tau).$$

Here the function $g(\tau)$ is immediately connected with the sources of radiation. The intensity of the radiation emitted from the medium under the angle arccos η with respect to the normal is expressed by the following formula:

$$I(\eta) = \int_0^\infty B(\tau) \, e^{\tau/\eta} \, (d\tau/\eta).$$

For the solution of this problem also a method will be found suitable which consists in the introduction of the exit probability of a quantum from the

Dokl.Akad.Nauk 111, fasc.5, 1000-1003 (1956) CARD 2 / 2 PA - 1989

medium. If this probability is known, the intensity of the radiation emitted by the medium can be expressed by means of a formula mentioned here for any radiation sources acting upon the medium. For the function $p(\tau, \eta)$ an integral equation is given the solution of which offers no difficulties. $p(\tau, \eta)$ here denotes the probability that a quantum absorbed in the optic depth τ leaves the medium under the angle arccos η with respect to the normal. However, in order to determine $p(\tau, \eta)$ also another equation can be set up, in which case the probability for the exit of a quantum from the depth $\tau + \Delta\tau$ is determined, i.e. the quantity $p(\tau + \Delta\tau\ \eta)$. Also for this case the integral equation is given. However, if λ depends on τ, this equation no longer holds good. But also in this case it is possible to write down a still more general integral equation. For this purpose the author studies the totality of the media in which the probability for the survival of the quantum is equal to $\lambda(\tau + \alpha)$, where α is a parameter.
In conclusion the equations obtained are specialized for three special cases.

INSTITUTION: State University LENINGRAD

SOBOLEV, V.V.

[Moving shells of stars] Dvizhushchiesja obolochki zvezd. Leningrad, Izd-vo Leningradskogo gos. ordena Lenina universiteta, 1957. 111 p.
(Stars--Atmospheres) (MIRA 10:6)
(Stars--Spectra)

SOBOLEV, V.V.

Diffusion of radiation with redistribution of frequencies. Part 3. [with summary in English]. Vest. LGU no.19:135-144 '57. (MIRA 11:1)
(Stars--Radiation) (Diffusion)

SOBOLEV, V. V.

33-3-5/32

AUTHOR: Sobolev, V.V.

TITLE: The diffusion of radiation in a medium of finite optical thickness. (Diffuziya izlucheniya v srede konechnoy opticheskoy tolshchiny)

PERIODICAL: "Astronomicheskiy Zhurnal" (Journal of Astronomy), 1957, Vol.34, No.3, pp. 336-348 (U.S.S.R.)

ABSTRACT: In a previous paper (1), the author proposed a new method of solving various problems in the theory of diffusion of radiation, based on calculating the probability of escape of a quantum from a medium. At first only semi-infinite media were considered. The theory was later applied to a finite medium (2). New results are now reported for the latter case. Special attention is paid to the case where optical thickness of the medium is large. The results now reported may be used in the study of diffusion of radiation in the nebulae, atmospheres of planets, etc.

The following problem is treated: the medium is assumed to consist of plane parallel layers, and has an optical thickness τ_0. The strength of sources of radiation is supposed to be a function of optical depth τ only. The probability that a quantum will survive an elementary act of scattering is denoted by λ (the albedo of a particle). With this notation it is desired to calculate the probability that a quantum absorbed

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33-3-5/32

The diffusion of radiation in a medium of finite optical thickness. (Cont.)

at a depth τ will escape from the medium (in general after diffusion) through the plane $\tau = 0$, at an angle arc cos η to the normal and within the solid angle $d\omega$. This probability is denoted by $p(\tau, \eta, \tau_0)$. The latter function may be determined from the following equation:

$$\frac{\partial p}{\partial \tau} = -\frac{1}{\eta} p(\tau, \eta, \tau_0) + \frac{\lambda}{2} \varphi(\eta, \tau_0) \int_0^1 p(\tau, \eta', \tau_0) \frac{d\eta'}{\eta'} - \frac{\lambda}{2} \psi(\eta, \tau_0) \int_0^1 p(\tau_0 - \tau, \eta', \tau_0) \frac{d\eta'}{\eta'},$$

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where:

$$\varphi(\eta, \tau_0) = 1 + \frac{\lambda}{2} \int_0^1 \frac{d\zeta}{\zeta} \int_0^{\tau_0} e^{-(\tau_0 - \tau)\left(\frac{1}{\eta} + \frac{1}{\zeta}\right)} \varphi(\eta, \tau) \varphi(\zeta, \tau) d\tau$$

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The diffusion of radiation in a medium of finite optical thickness. (Cont.)

both subject to the condition $\tau_0 \gg 1$. The asymptotic forms of $\varphi(\eta, \tau_0)$ and $\psi(\eta, \tau_0)$ corresponding to case i) are:

$$\varphi(\eta_0 \tau_0) = \varphi(\eta) - C \frac{\eta}{1 - k\eta} \varphi(\eta) e^{-2k\tau_0}$$

and

$$\psi(\eta, \tau_0) = C_1 \frac{\eta}{1 - k\eta} \varphi(\eta) e^{-k\tau_0}$$

where C and C_1 are constants given by:

$$C \int_0^1 \frac{\varphi(\eta)}{(1 - k\eta)^2} \eta d\eta = C_1 \int_0^1 \frac{\varphi(\eta)}{1 - k^2\eta^2} \eta d\eta$$

Card 4/7 and

$$C_1 \int_0^1 \frac{\varphi(\eta)}{(1 - k\eta)^2} \eta d\eta = 2k \int_0^1 \frac{\varphi(\eta)}{1 - k^2\eta^2} \eta d\eta$$

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The diffusion of radiation in a medium of finite optical thickness. (Cont.)

The asymptotic forms of $\varphi(\eta, \tau_0)$ and $\psi(\eta, \tau_0)$ corresponding to case ii) are:

$$\varphi(\eta, \tau_0) = \varphi(\eta) - \frac{\eta\varphi(\eta)}{\tau_0 + \gamma}$$

and

$$\psi(\eta, \tau_0) = \frac{\eta\varphi(\eta)}{\tau_0 + \gamma}$$

where γ is a constant and is given by:

$$\gamma = 2 \frac{\int_0^1 \varphi(\eta)\eta^2 d\eta}{\int_0^1 \varphi(\eta)\eta^1 d\eta}$$

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Finally, the intensity of radiation emerging from a medium is calculated for different distributions of sources of radiation. The intensities of radiation passing through the upper and lower boundaries are respectively given by:

The diffusion of radiation in a medium of finite optical thickness. (Cont.)

$$I(0, \eta, \tau_0) = \int_0^{\tau_0} p(\tau, \eta, \tau_0) f(\tau) \frac{d\tau}{\eta},$$

$$I(\tau_0, \eta, \tau_0) = \int_0^{\tau_0} p(\tau_0 - \tau, \eta, \tau_0) f(\tau) \frac{d\tau}{\eta}$$

where $f(\tau)d\tau$ is the amount of energy which comes directly from the sources of radiation and is absorbed per second by an elementary volume of thickness $d\tau$ and unit cross-section, at a depth τ. It is supposed that sources of radiation are within the medium and emit equal amounts of energy in all directions. Thus, one may put:

$$f(\tau) = \frac{4\pi}{\lambda} g(\tau)$$

Card 6/7 where $g(\tau)d\tau$ is the amount of energy emitted per second by the sources in an elementary volume $1 \times d\tau$ per unit solid angle.

Sobolev

33-5-3/12

AUTHOR: Sobolev, V. V.

TITLE: The Diffusion of L_α-radiation in Nebulae and Stellar Envelopes. (Diffuziya L_α-Izlucheniya v Tumannostyakh i Zvezdnykh Obolochkakh).

PERIODICAL: Astronomicheskiy Zhurnal, 1957, Vol.34, No.5, pp. 694-705 (USSR).

ABSTRACT: Photoionization of hydrogen in gaseous nebulae and the subsequent recombination lead to the appearance of L_α quanta. Because of the large optical thickness of nebulae in Layman lines, these quanta take some time to diffuse through nebulae. For this reason the density of L_α quanta in nebulae turns out to be very high. The problem of the diffusion of the latter quanta is of major interest for various reasons. In particular, the radiation pressure due to these quanta plays a major role in the dynamics of nebulae and stellar shells. In the present paper the problem of diffusion of L_α-radiation with full redistribution of frequences, an arbitrary absorption function, and an arbitrary velocity gradient in the medium is considered. The general solution of the problem leads to the solution to the following special cases: 1. large velocity gradient

Card 1/3 (compare Ref. 3 by the present author) and 2. stationary

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33-5-3/12

The Diffusion of L_α-radiation in Nebulae and Stellar Envelopes.

6 and 11). There are no figures, no tables, 13 references, 5 of which are Slavic, including 4 by the present Author.

SUBMITTED: June, 4, 1957.

ASSOCIATION: Leningrad State University imeni A. A. Zhdanov. (Leningradskiy Gosudarstvennyy Universitet im. A. A. Zhdanova)

AVAILABLE: Library of Congress.

Card 3/3

function $g(\tau)$ characterizes the distribution of the radiation sources. If the function $B(\tau)$ is found, the intensities of the radiation can be expressed by certain formulae given here. The formal solution of the initially given integral equations has the form $B(\tau) = g(\tau) + \int_0^\infty \Gamma(\tau, \tau') g(\tau') d\tau'$, where $\Gamma(\tau, \tau')$ denotes the kernel. Next, an equation for the determination of the kernel is given. The further development of the computations is followed. The determination of the field of radiation in a semiinfinite medium is reduced to the determination of a function $\Phi(\tau)$. Next, the author investigates the following special cases of this problem: 1.) Be it assumed that $g(\tau) = Ge^{-m\tau}$, where G and m are constants. 2.) Be it that $g(\tau) = \tau^n$, where n is a integer, positive number. 3.) Be it assumed that in the medium a pure scattering of radiation takes place and the radiation sources are located in an infinitely great depth. There are 3 Slavic references.

SOBOLEV, V. V.

Voprosy kosmogonii, t. 6 (Problems in Cosmogony, Vol. 6) Moscow, Izd-vo AN SSSR, 1958. 367 p. 2,000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Astronomicheskiy sovet.

ARTICLES

REPORTS

SOBOLEV, V.V.

Physics of planetary nebulae [with summary in English]. Vop.kósm. 6:112-156 '58. (MIRA 11:10)
(Nebulae) (Cosmic physics)

16(1)

AUTHOR: Sobolev, V.V. SOV/22-11-5-3/9

TITLE: On the Theory of Radiation Diffusion (K teorii diffuzii izlucheniya)

PERIODICAL: Izvestiya Akademii nauk Armyanskoy SSR, Seriya fiziko-matematicheskikh nauk, 1958, Vol 11, Nr 5, pp 39 - 50 (USSR)

ABSTRACT: The present results generalize the results of V.A. Ambartsumyan [Ref 1,2] and of the author [Ref 3,4,5]. Integral equations of the type

$$B(\tau) = \int_0^\infty K(\tau - \tau')B(\tau')d\tau' + g(\tau)$$

are considered. Principally new results are not obtained, since the same equations have been already explicitly treated by V.A. Fok [Ref 6]. The use of a certain function of one variable $\phi(\tau)$ is only new, by which the resolvent $\Gamma(\tau,\tau')$ can be expressed (Fok used Fourier series). The application of the results to the radiation diffusion in a plane layer seems to be of interest and an probability theoretical interpretation of

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On the Theory of Radiation Diffusion SOV/22-11-5-3/9

the diffusion problem in which it is referred to the paper /Ref 13/ of L.M. Biberman and B.A. Veklenko.
There are 13 references, 10 of which are Soviet, 1 is American, 1 Japanese, and 1 Swedish.

ASSOCIATION: Leningradskiy gosudarstvennyy universitet (Leningrad State University)

SUBMITTED: July 15, 1958

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OGORODNIKOV, K.F.; SOBOLEV, V.V.

Petr Mikhailovich Gorshkov; on his 75th birthday. Vest. LGU 13 no.13:5-10 '58. (MIRA 11:8)
(Gorshkov, Petr Mikhailovich, 1883-)

SOV/20-120-1-17/63

AUTHOR: Sobolev, V. V.

TITLE: The Diffusion of Radiation in a Plane Layer (Diffuziya izlucheniya v ploskom sloye)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol. 120, Nr 1, pp. 69 - 72 (USSR)

ABSTRACT: In a previous paper written by the author (Ref 1) the diffusion of the radiation in a semiinfinite medium was investigated using a probability method (Refs 2,3) earlier proposed by the author. The present paper investigates by means of the same method the diffusion of the radiation in a plane layer of the finite optical density τ_0. An isotropic scattering of the radiation with the survival probability λ of the quantum occurred in the elementary volume of the medium. The calculation of the radiation field in the medium reduces to the determination of the function $B(\tau, \tau_0)$ from the equation

$$B(\tau, \tau_0) = \frac{\lambda}{2}\int_0^{\tau_0} B(\tau', \tau_0) Ei\,|\tau - \tau'|\, d\tau' + g(\tau),$$

where the function $g(\tau)$ represents the arrangement of the

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radiation sources. The solution of the above mentioned equation can be arranged in the form

$$B(\tau, \tau_0) = g(\tau) + \int_0^{\tau_0} \Gamma(\tau', \tau, \tau_0) g(\tau') d\tau'$$ where $\Gamma(\tau', \tau, \tau_0)$ denotes the resolvent. The quantity (τ', τ, τ_0) represents the probability for the fact that the quantum radiated between the optical depths τ' and $\tau' + d\tau'$ is later (i.e. after the diffusion in the medium) radiated between the optical depths τ and $d\tau$. Taking into account the probability meaning of the resolvent and using the method of the addition of the layers as proposed by V.A.Ambartsumyan (Ref 4) a relatively simple equation for the determination of the resolvent can be obtained. The equations resulting after the addition of a layer of the small optical density $\Delta\tau$ to the upper and lower boundary of the medium are written down and dealt with. Together with the resolvent $\Gamma(\tau', \tau, \tau_0)$ the probability for the exit of the quantum from the medium is introduced to the present consideration. The corresponding intensities of the radiation emitted through the upper and lower boundary are calculated. The further course of the calculation is followed step by step. The function

$\Phi(\tau, \tau_0)$ occurring in the treated equation must play an important rôle in the theory of the diffusion of the radiation. When this function is known the radiation field in a plane layer in the case of arbitrary radiation sources can be determined. Finally the author deals in short with the 3 following examples: equal distribution of the radiation sources in the medium; the medium is illuminated by parallel rays impinging at a certain angle; the determination of the total probability of the exit of the quantum from the medium. There are 4 references, which are Soviet.

PRESENTED: February 6, 1958, by V.A.Ambartsumyan, Member, Academy of Sciences, USSR

SUBMITTED: February 1, 1958

1. Radiation--Theory 2. Radiation--Scattering 3. Diffusion --Mathematical analysis

SOV/20-122-1-10/44

3(1)

AUTHOR: Sobolev, V. V.

TITLE: On the Luminosity of Hot Stars (O svetimosti goryachikh zvezd)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol 122, Nr 1, pp 41-43 (USSR)

ABSTRACT: This paper deals with the determination of the luminosity of the WR stars and of the white dwarfs. Stars of the type WR: A consistent theory of the WR stars must take into account that absorption is caused by real atoms (hydrogen, helium) and that high-frequency radiation is converted to quanta of lower frequency in the atmosphere of the star. The results of some papers (Refs 4, 5) may be used for the determination of the luminosity of the WR stars. Approximately, the star (without the atmosphere) is assumed to radiate according to Planck's (Plank) law. The temperature of the star can be found according to the improved theory of Zanstr. For the determination of the star radius, however, the fact must be taken into consideration that the fluorescence excited in the atmosphere increases the visible brightness of the star considerably. According to the theory, the influence

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of the atmosphere on the visible brightness amounts to some star magnitudes. The influence of the radiation of the shell on the brightness of a star may be found approximately by observation; this manner of determination is discussed in short. The white dwarfs: The high gravitational acceleration in the atmosphere of the white dwarfs causes the following 2 effects: 1) The degree of the ionization of the atoms is lower in the atmosphere of a white dwarf than in the atmosphere of an "ordinary" star of the same temperature. 2) The absorption lines in the spectrum of a white dwarf are very diffuse because of the Stark effect. It is possible that the temperatures of the white dwarfs are higher than the generally assumed values. The following facts are arguments in favor of this hypothesis: There is no Balmer discontinuity (Balmerov skachek) in the spectra of the white dwarfs. 3) The absorption in the higher members of the Balmer series has a great influence on the light of the white dwarfs. Grenchik's (Ref 9) model of the atmosphere of the white dwarf 40 Eridan B with T_e = 13 800^o and lg g does not agree well with the observed results. 4) The radius of Sirius B is more than twice as large than the theoretical radius. 5) Some white dwarfs have spectra without absorption lines and with faint emission

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SOBOLEV, V.V.

Diffusion of radiation in a medium with variable optical properties. Uch.zap.LGU no.273:3-13 '58. (MIRA 12:1)
(Astrophysics)

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24.4500
~~24 (3)~~

SOV/20-129-6-18/69

AUTHOR: Sobolev, V. V., Corresponding Member, AS USSR

TITLE: Some Problems in the Theory of Radiation Diffusion

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 129, Nr 6, pp 1265 - 1268 (USSR)

ABSTRACT: The present paper raises and solves several of the problems mentioned in the title, which, at the first glance, appear to differ considerably, but may, in reality, be reduced to integral equations of the same type. First, a semi-infinite medium is dealt with, which consists of plane-parallel layers and is able to absorb and emit radiation. This medium is assumed to be bounded by a reflecting surface with a reflection coefficient 1. In this case, the function $B(\tau)$ is determined by the integral equation $B(\tau) = \frac{\lambda}{2}\int_0^\infty \left[Ei|\tau - t| + Ei(\tau + t)\right] B(t)dt + g(\tau)$. Here B denotes the ratio between the emission coefficient ε and the absorption coefficient α. In the case under investigation, B depends only on the optical depth τ. Further, $g(\tau) = \varepsilon_0/\alpha$ holds, and ε_0 denotes the emission coefficient due to direct radiation

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Some Problems in the Theory of Radiation Diffusion 68155 SOV/20-129-6-18/69

sources. Next, a spherical planetary nebula with a star in its center is assumed. The thickness of this nebula is assumed to be much smaller than its radius. The diffusion of L_c quanta in the nebula is described by the integral equation $B(\tau) = \frac{\lambda}{2}\int_0^\infty \left[Ei|\tau - t| + Ei(\tau + t)\right] B(t)dt + \frac{\lambda S}{4} e^{-\tau}$. Here πS denotes the flux of the L_c quanta, which impinge upon the inner surface of the nebula from the star. A point radiation source is then assumed to be in a homogeneous unbounded medium (e.g. a gas in a gas- or dust nebula). According to V. A. Ambartsumyan, determination of the radiation field is in this case reduced to solving the integral equation $A(\tau) = \frac{\lambda}{2}\int_0^\infty \left[Ei|\tau - t| + Ei(\tau + t)\right] A(t)dt + \frac{\lambda L\alpha^2}{16\pi^2} Ei\tau$ with $A(\tau) = \int_0^\infty B(t)tdt$ (L is the source strength, τ the optical distance from the source). The hitherto given integral equations differ from one another only by their free terms. The second and the third integral equation may be regarded as special cases of

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Some Problems in the Theory of Radiation Diffusion SOV/20-129-6-18/69

the first. The first integral equation may be solved by employing a method already previously described by the author (Ref 3). Calculation up to solution is followed step by step, and the resolvent is explicitly written down. Finally, several special cases of the aforementioned first integral equation are dealt with. With $g(\tau) = e^{-\tau/\zeta}$, $B(\tau,\zeta) = e^{-\tau/\zeta} + \frac{1}{2}\int_0^\infty \Phi(t)\left[e^{-|\tau-t|/\zeta} + e^{-(\tau+t)/\zeta}\right]dt$ holds. In the case of a point light source, $B(\tau) = -\frac{L\alpha^2}{16\pi^2\tau}\Phi'(\tau)$, and with $g(\tau) = 1$, $B(\tau) = \frac{1}{1-\lambda}$ holds. There are 4 Soviet references.

SUBMITTED: September 16, 1959

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MIKHAYLOV, A.A., otv.red.; ZVEREV, M.S., red.; KULIKOVSKIY, P.G., red.; MASEVICH, A.G., red.; MUSTEL', E.R., red.; SOBOLEV, V.V., red.; SUBBOTIN, M.F., red.; SAMSONENKO, L.V., red.; TUMARKINA, N.A., tekhn.red.

[Astronomy in the U.S.S.R. during forty years 1917-1957; collected articles] Astronomiia v SSSR za sorok let, 1917-1957; sbornik statei. Red.kollegiia: A.A.Mikhailov i dr. Moskva, Gos.izd-vo fiziko-matem.lit-ry, 1960. 728 p. (MIRA 13:7)

(Astronomy--History)

Sobolev, V. V.

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PHASE I BOOK EXPLOITATION SOV/4374

Astronomiya v SSSR za sorok let 1917 - 1957; sbornik statey (Forty Years of Astronomy in the USSR, 1917-1957; Collection of Articles) Moscow, Fizmatgiz, 1960. 729 p. 2,000 copies printed.

Ed.: L. V. Samsonenko; Tech. Ed.: N. A. Tumarkina; Editorial Board: A. A. Mikhaylov (Resp. Ed.), M. S. Zverev, P. G. Kulikovskiy, A. G. Masevich, E. R. Mustel'; V. V. Sobolev, and M. F. Subbotin.

PURPOSE: This book is intended for astronomers, astrophysicists, and others interested in the history of astronomy in the USSR.

COVERAGE: This major work on the history of astronomy in the USSR consists of two parts, review articles and bibliographies. Part I contains a collection of articles on various facets of astronomical research written by leading Soviet specialists in the field. Chief emphasis is placed on developments of the last ten years. The research activities and equipment of 23 Soviet observatories and institutes are described, and the leading scientific personalities of each mentioned. The geographic coordinates and elevations of 41 astronomical centers are listed. Individual articles discuss problems dealing with

PART II. BIBLIOGRAPHY

Card 2/3

AMBARTSUMYAN, Viktor Amazaspovich; ARAKELYAN, M.A. [translator]; MIRZOYAN, L.V. [translator], red.; PARSAMYAN, E.S. [translator]; TOVMASYAN, G.M. [translator]; KHACHIKYAN, E.Ye. [translator]; SOBOLEV, V.V., red.; KAPLANYAN, M.A., tekhn.red.

[Scientific works in two volumes] Nauchnye trudy v dvukh tomakh. Pod red. V.V.Soboleva. Erevan, Izd-vo Akad.nauk Armianskoi SSR. Vol.1. 1960. 428 p. Vol.2. 1960. 360 p. (MIRA 13:11)

1. Sotrudniki Byurakanskoy astrofizicheskoy observatorii (for Arakelyan, Mirzoyan, Parsamyan, Tovmasyan, Khachikyan).
(Astronomy)

3.1570

73001
SOV/33-37-1-1/31

AUTHOR: Sobolev, V. V.

TITLE: Concerning the Brightness of a Spherical Nebula

PERIODICAL: Astronomicheskiy zhurnal, 1960, Vol 37, Nr 1, pp. 3-8 (USSR)

ABSTRACT: The dispersion of light in a medium consisting of plane-parallel layers has been recently investigated in great detail by various authors. But a similar problem where the medium has spherical symmetry has been largely neglected. The author attempts to give an approximate solution of the following particular case: given a uniform material sphere with a radiation source at its center; inside this sphere light is dispersed with a given probability of quantum life-time and a given index of dispersion; it is required to compute the radiation field. In this case the equation of radiative transfer may be written:

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$$\cos\vartheta \frac{\partial I(\tau,\vartheta)}{\partial\tau} - \frac{\sin\vartheta}{\tau}\frac{\partial I(\tau,\vartheta)}{\partial\vartheta} = -I(\tau,\vartheta) + B(\tau,\vartheta). \qquad (2)$$

Here I is the intensity of diffused radiation, r is the distance from the center, $\tau = \alpha r$, α is the absorption coefficient, ϑ is the angle between the direction of the radiation and the direction of the dispersed radiation, and B is given by the expressions:

$$\frac{1}{2\pi}\int_0^{2\pi} x(\gamma)\,d\varphi = p(\vartheta,\vartheta') \qquad (5)$$

$$\frac{L\alpha^2}{16\pi^2} = A, \qquad (6)$$

$$B(\tau,\vartheta) = \frac{\lambda}{2}\int_0^{\pi} I(\tau,\vartheta')\,p(\vartheta,\vartheta')\sin\vartheta'\,d\vartheta' + \lambda x(\vartheta)\frac{A}{\tau^2}e^{-\tau}. \qquad (7)$$

Concerning the Brightness of a Spherical Nebula

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SOV/33-37-1-1/31

Here ϑ is the azimuth in a spherical system of coordinates: L is the energy of radiation per second; , the probability of a quantum life-time; x ( ) is the index of dispersion of light by an elementary volume. The problem is to find the values of I and B from equations (2) and (7). The author explains his method of solving these equations and discusses two particular cases: (1) There is real absorption of light in this field; (2) there is pure dispersion in this field. He then attempts to apply his solution to dust nebulae by assuming the following quantities known from observation: optical radius $_{o}$ equal to r_{o}, and the radius of the nebula, r_{o}. It is more difficult to obtain x ( ) and , which may be determined by studying the distribution of the brightness over the nebular disk. The author believes that the application of his formulae to dust nebulae will lead to a knowledge of the optical properties of such nebulae and the nature

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Concerning the Brightness of a Spherical Nebula

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of dust particles. There is 1 figure and 2 references, 1 Soviet and 1 U.K. The U.K. reference is Chandrasekhar, Radiative Transfer, in Russian translation.

ASSOCIATION: Leningrad State University (Leningradskiy gosudarstvennyy universitet)

SUBMITTED: September 1, 1959

Card 4/4

SOBOLEV, V.V.

Theory of stellar evolution. Astron.zhur. 37 no.3:387-395 My-Je '60. (MIRA 13:6)

1. Astronomicheskaya observatoriya Leningradskogo gosudarstvennogo universiteta.
(Stars)

SOBOLEV, V.V.

Some cosmogonic consequences of the statistics of binary stars. (MIRA 14:9)
Astron.zhur. 38 no.5:920-926 S-O '61.

1. Leningradskiy gosudarstvennyy universitet im. A.A.Zhdanova.
(Stars, Double)

SOBOLEV, V.V.; MININ, I.N.

Isotropic light scattering in an atmosphere with finite optical thickness. Astron.zhur. 38 no.6:1025-1032 N-D '61. (MIRA 14:11)

1. Astronomicheskaya observatoriya Leningradskogo gosudarstvennogo universiteta im. A.A.Zhdanova.
(Light--Scattering)

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S/020/61/136/003/010/027
B019/B054

9.9000 (also 1036, 1103)

AUTHOR: Sobolev, V.V., Corresponding Member of the AS USSR

TITLE: The Diffusion of Radiation Into a Medium With Mirror-reflecting Boundaries

PERIODICAL: Doklady Akademii nauk SSSR, 1961, Vol. 136, No. 3, pp. 571 - 574

TEXT: The author assumes that the reflection coefficient depends on the angle of incidence. For the ratio between radiation factor and the absorption factor he gives the relation

$$B(\tau) = \frac{\lambda}{2}\int_0^{\infty}\left[Ei|\tau - t| + K(\tau + t)\right] B(t)dt + g(\tau) \qquad (2)$$

$$K(\tau) = \int_0^1 r(\xi)e^{-\tau/\xi}\,\frac{d\xi}{\xi} \qquad (3)$$

$r(\xi)$ is the reflection coefficient and ξ the cosine of the angle of incidence. A similar formula has already been derived in one of the author's

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earlier papers, in which case, however, he did not take the angular dependence of the reflection coefficient into account. The analogous relation $B^*(\tau)$ (4) is written down. The resolvents of (2) and (4) are determined by means of the equations

$$\frac{\partial\Gamma}{\partial\tau} + \frac{\partial\Gamma^*}{\partial t} = \Phi^*(\tau)\Phi(t)$$
$$\frac{\partial\Gamma^*}{\partial\tau} + \frac{\partial\Gamma}{\partial t} = \Phi(\tau)\Phi^*(t) \qquad (5)$$

$\Gamma(\tau,t)$ and $\Gamma^*(\tau,t)$ are the resolvents and $\Phi(\tau) = \Gamma(0,\tau)$, $\Phi^*(\tau) = \Gamma^*(0,\tau)$ holds. Thus the problem is reduced to determination of the functions $\Phi(\tau)$ and $\Phi^*(\tau)$. After complex calculations, the following integral is obtained:

$$\Phi(\tau) = C(k)e^{-k\tau} + 2\lambda\int_1^{\infty}\frac{xe^{-x\tau}\,A(1/x)\,dx}{(\lambda\pi)^2+(2x+\ln\frac{x-1}{x+1})^2}$$

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The Diffusion of Radiation Into a Medium With Mirror-reflecting Boundaries

S/020/61/136/003/010/027
B019/B054

$$C(k) = \frac{k(1-k^2)}{\lambda+k^2-1}\left\{1-\frac{\lambda}{2}\int_0^1\frac{B(0,\xi)}{1+k\xi}\,d\xi+\frac{\lambda}{2}\int_0^1\frac{B(0,\xi)}{1-k\xi}\,r(\xi)d\xi\right\},$$

$$A(\eta) = 1 + r(\eta) - \frac{\lambda}{2}\eta\int_0^1\frac{B(0,\xi)}{\eta+\xi}\left\{1-r(\eta)r(\xi)\right\}d\xi -$$

$$-\frac{\lambda}{2}\eta\int_0^1\frac{B(0,\xi)}{\eta-\xi}\left\{r(\eta)-r(\xi)\right\}d\xi$$

X

In this case it is assumed that $A(\eta)$ has no singularities. The expression for $\Phi^*(\tau)$ is obtained from the above equation by the substitution of $-r(\xi)$ for $r(\xi)$. Two further special cases of (18) are studied: Without inner reflection ($r = 0$) and with complete inner reflection ($r = 1$). V.A. Ambartsumyan and I.N. Minin are mentioned. There are 4 Soviet references.

Card 3/4

GURZADYAN, Grigor Aramovich; AMBARTSUMYAN, V.A., red.; MUSTEL', E.R., red.; SEVERNYY, A.B., red.; SOBOLEV, V.V., red.; KULIKOV, G.S., red.; BRUDNO, K.F., tekhn. red.

[Planetary nebulae]Planetarnye tumannosti. Moskva, Gos.izd-vo fiziko-matem.lit-ry, 1962. 384 p. (MIRA 15:9)
(Nebulae)

AGEKYAN, T.A.; VORONTSOV-VEL'YAMINOV, B.A.; GORBATSKIY, V.G.; DEYCH, A.N.; KRAT, V.A.; MEL'NIKOV, O.A.; SOBOLEV, V.V.; MIKHAYLOV, A.A., otv. red.; KULIKOV, G.S., red.; AKSEL'ROD, I.Sh., tekhn. red.

[Course on astrophysics and stellar astronomy]Kurs astrofiziki i zvezdnoi astronomii. 2. izd. Moskva, Fizmatgiz. Vol.2. [By]T.A. Agekian i dr. 1962. 688 p. (MIRA 16:1)
(Astrophysics) (Stars) (Nebulae)

S/560/62/000/014/001a/011

AUTHOR: Sobolev, V. V., and I. N. Minin

TITLE: Light scattering in a spherical atmosphere. I.

PERIODICAL: Akademiya nauk SSSR. Iskusstvennyye sputniki Zemli, no. 14, 1962, 7-12

TEXT: Light scattering in an atmosphere consisting of spherical layers (e.g., when the sun is low on the horizon or beneath it) is examined. An approximate solution of equations for the intensity of radiation (I) and the total quantity of radiation (B) is proposed on the basis of a method used by V. V. Sobolev to solve the problem of light scattering in a medium consisting of plane-parallel layers. First order scattering is accounted for precisely, while scattering of higher orders is approximated. Here only the first two components are used in the expansion of the scattering indicatrix in Legendre polynomials. The equations obtained are valid for all relationships of the coefficient of absorption (α) to the distance (r) of an arbitrary point in the atmosphere from the center of the planet.

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Two special cases are considered: 1) where α is constant in the atmosphere and 2) where α decreases exponentially with height. Case (1) may be presumed to exist when the sky is totally overcast and case (2), when it is clear. The computations could be simplified if it were assumed that the thickness of the atmosphere is considerably less than the radius of the planet, as is actually the case. Light scattering in the Venusian atmosphere is recognized as a special case. Here the atmosphere consists of two layers: a cloudy layer with an approximately constant α and an underlying gaseous layer with varying α.

SOBOLEV, V.V.

Some relations in the theory of light scattering. Astron.zhur. 39 no.2:229-234 Mr-Ap '62. (MIRA 15:3)

1. Leningradskiy gosudarstvennyy universitet im. A.A.Zhdanova. (Light--Scattering)

SOBOLEV, V.V.

Hydrogen lines in prominences spectra. Astron.zhur. 39 no.4:632-642 Jl-Ag '62. (MIRA 15:7)

1. Leningradskiy gosudarstvennyy universitet.
(Sun--Prominences--Spectra)

SOBOLEV, V.V.; IVANOV, V.V.

Intensity of hydrogen emission lines in stellar spectra. Uch.zap.LGU no.307:3-17 '62. (MIRA 15:9)
(Stars--Spectra)

GORBATSKIY, V.G.; MININ, I.N.; ; AMBARTSUMYAN, V.A., red.; BUSTEL', E.R., red.; SEVERNYY, A.B., red.; SOBOLEV, V.V., red.; KULIKOV, G.S., red.; AKSEL'ROD, I.Sh., tekhn. red.

[Nonstable stars] Nestatsionarnye zvezdy. Moskva, Fizmatgiz, 1963. 355 p. (MIRA 16:4)

(Stars, Variable)

KAPLAN, Samuil Aronovich; PIKEL'NER, Solomon Borisovich; AMBARTSUMYAN, V.A., red.; MUSTEL', E.R., red.; SEVERNYY, A.B., red.; SOBOLEV, V.V., red.; KULIKOV, G.S., red.; AKSEL'ROD, I.Sh., tekhn. red.

[Interstellar medium] Mezhzvezdnaia sreda. Moskva, Fizmatgiz, 1963. 531 p. (MIRA 17:2)

ACCESSION NR: AP4003731 S/0293/63/001/002/0227/0234

AUTHOR: Minin, I. N.; Sobolev, V. V.

TITLE: Light scattering in a spherical atmosphere.

SOURCE: Kosmicheskiye issledovaniya, v. 1, no. 2, 1963, 227-234

TOPIC TAGS: atmospheric light scattering, spherical atmosphere, planetary atmosphere, atmospheric layer curvature, light scattering, light reflection, outgoing radiation, atmospheric absorption, atmospheric optical thickness, planet reflected light, homogeneous sphere luminescence.

ABSTRACT: The article is a continuation of the authors' previous work on the scattering of light in a planetary atmosphere which accounts for the curvature of atmospheric layers (V. V. Sobolev, I. N. Minin. Sb. "Iskusstvenny*ye Sputniki Zemli," vy* p. 14. Izd-vo AN SSSR, 1962, str. 7). In the present article, the case of a constant atmospheric absorption coefficient is considered. An analytical solution is obtained for the basic equation determining the mean intensity of the diffused radiation, J, at a point in the atmosphere, subject to boundary conditions. These conditions assume that there exists no diffused radiation incident upon the atmosphere from

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Card

ACCESSION NR: AP4003731

the outside, and they account for the reflection of light from the planet's surface. The expression for the quantity J of a homogeneous sphere is derived for the optical thickness of the atmosphere, which is large in comparison to the planet dimensions. The result is similar to, but simpler than that obtained by R. G. Giovanelli and J. T. Jefferies (Proc. Phys. Soc., 69, No. 11, 1077, 1956). From the knowledge of J, the ratio B of the radiation coefficient to the absorption coefficient can be derived for any point. The intensity of radiation leaving the atmosphere is then expressed as:

$$I = \int_0^{T_0} B e^{-T_1} dT_1 + I^* e^{-T_0},$$

where T_1 is the range along a ray of light between a point in the atmosphere and the observer, T_0 is the total path traveled by the ray in the atmosphere, and I^* is the intensity of radiation due to reflection from the planet's surface. The integral of the equation is written as $I_1 + \Delta I$, where I_1 is the intensity due to first order scattering and ΔI represents higher

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ACCESSION NR: AP4003731

orders. For the case when the atmosphere can be approximated by a homogeneous sphere and the observer is at a far field, the coordinates of any point are easily expressed in terms of T_1, and an explicit expression for I_1 is found. This expression is further simplified by assuming an atmosphere with large radius. The resulting expressions for I_1 closely approximate the total intensity of scattered light for small values of λ, the albedo of the scattering particle, or for small values of γ, the angle between the direction of light incident on the planet and the ray directed toward the observer. It is further pointed out that entirely different expressions are found for I_1 when the atmosphere is assumed to consist of plane and parallel layers. Orig. art. has: 43 formulas and 3 figures.

ASSOCIATION: None

SUBMITTED: 20Feb63 DATE ACQ: 26Dec63 ENCL: 00

SUB CODE: AS NO REF SOV: 001 OTHER: 001

3/3

Card

ACCESSION NR: AM3001208 S/9012/63/000/175/0004/0004

AUTHOR: Sobolev, V. (Corresponding Member, Academy of Sciences USSR)

TITLE: Space -- the laboratory of modern physics

SOURCE: Pravda, 24 Jun 63, p. 4, cols. 4-6

TOPIC TAGS: The study of universe, possibilities of setting the astrophysical observatories in space

TEXT: Many different sciences are presently concerned with the study of the universe; the newest of these is space astrophysics, product of the marriage of astrophysics and rocketry and the solution to the problem of placing an observer outside the terrestrial atmosphere. Sobolev states that the UV spectra of stars will surface temperatures of 10,000 to 20,000 degrees have been obtained by means of rocket-borne instruments; it is felt that it would be a significant advance if the UV spectra of hot stars with low luminosity, the "white dwarfs," could also be obtained. The flights of Bykovskiy and Tereshkova have brought science closer to a new advance: the day is approaching when there will be astrophysical observatories in space, and astronomers will land on the planets of the solar system.

SPAO - Item no. 19

DATE ACQ: 28Jun63

EWT(1)/FCC(w)/BDS/ES(v)--AFFTC/ASD/ESD-3/APGC/SSD--

L 11192-63
Pe-4/Pi-4--GW

S/0033/63/040/003/0496/0503 69 68

ACCESSION NR: AP3001243

AUTHOR: Minin, I.N.; Sobolev, V.V.

TITLE: Contribution to the theory of the scattering of light 12 in planetary 12 atmospheres

SOURCE: Astronomicheskiy zhurnal, v. 40, no. 3, 1963, 496-503

TOPIC TAGS: planetary atmosphere, scattering of light, luminosity of planetary atmosphere, twilight phenomena, terminator

ABSTRACT: This theoretical paper examines the problem of the scattering of light in a spherical atmosphere, continuing and extending the investigation reported in the authors' paper in "Iskusstvennyye sputniki Zemli (Artificial Earth satellites)", no. 14, Izd-vo AN SSSR, Moscow, 1962, in which the problem is approximately reduced to a certain differential equation. In the present paper the problem is reduced to an integral equation. The solution of this problem is essential for the study of the luminosity of a planet in the vicinity of the terminator, i.e., that region of the planet in which the altitude of the sun over the horizon is low, also for the construction of a theory of twilight phenomena. The integral equation for the source function is developed on the premise of

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isotropic scattering of the light. For the sake of simplicity, the planetary atmosphere is imagined to consist of plane-parallel layers. However, it is assumed that these layers, in a given locality, are illuminated by the solar rays as though they were part of a spherical atmosphere. The reflection of the light from the planetary surface is taken into account. If it is assumed that the atmospheric layers are illuminated by parallel solar rays at each point, then the equation obtained thereby yields the well-known equation of the theory of the scattering of radiation in a planetary atmosphere. The integral equations obtained in the present paper will subsequently be numerically solved for various cases. In particular, the authors intend to examine in detail the case of a gaseous atmosphere in which the absorption coefficient decreases exponentially with elevation, also the case of a two-layer atmosphere consisting of a lower cloud-filled layer and an upper gaseous layer. The results of the calculation will be applied to the study of the luminosity of the atmospheres of the Earth and other planets when the sun is at a low local altitude. Here the first-order scattering will be taken into account exactly, the higher-order scattering approximately. It is further intended to generalize the results of this study. There are 46 numbered equations and 2 figures.

ASSOCIATION: Astronomicheskaya observatoriya Leningradskogo gos. universiteta

MINIH, I.N.; SOBOLEV, V.V.

Light scattering in a spherical atmosphere. Kosm. issl. 2 no.4:610-618 Jl-Ag '64. (MIRA 17:9)

MININ, I. N.; SOBOLEV, V. V.

"Light scattering in the spherical atmosphere."

paper presented at the Atmospheric Radiation Symp, Leningrad, 5-12 Aug 64.

S/0293/64/002/004/0610/0618

ACCESSION NR: AP4043498

AUTHOR: Minin, I. N., Sobolev, V. V.

TITLE: Light scattering in a spherical atmosphere. Part III

SOURCE: Kosmicheskiye issledovaniya, v. 2, no. 4, 1964, 610-618

TOPIC TAGS: planetary atmosphere, light scattering, atmospheric optics, atmospheric absorption coefficient, planet brightness, planotary albedo

ABSTRACT: In this article, as in the previous parts of their study (Iskusstvenny*ye sputniki Zemli, No. 14, Izd-vo AN SSSR, 1962, p. 7; Kosmicheskiye issledovaniya, 1, No. 2, 227, 1963), the authors consider the problem of diffusion of radiation in a planetary atmosphere illuminated by the sun's rays. The curvature of atmospheric layers is taken into account. In the earlier studies the principal equations of the problem were derived and a solution was found for a case when the absorption coefficient for the atmosphere is constant. In this third part of the study the assumption is made that the absorption coefficient decreases exponentially with height. The problem is solved in the first approximation and the following computations were made: 1. brightness of the planet near the terminator, and 2. brightness of the zenith during observations from the

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ACCESSION NR: AP4043498

earth's surface for different zenith distances of the sun. Table 2 in the original gives the brightness of a planet near the terminator. Table 3 gives the values I_0 and ΔI (where I_0 is the intensity caused by first-order scattering in the case of a spherical indicatrix of scattering and ΔI is the intensity caused by scattering of higher orders) as a function of solar zenith distance ψ for different values of the optical thickness τ_0 of the atmosphere. The value ΔI is given for two values of the albedo of a planetary surface ($A = 0.2$ and $A = 0.8$), approximately corresponding to summer and winter conditions. These data show that the relative role of higher-order scattering changes little with a change in solar zenith distance. Table 4 gives the values of the total brightness of the zenith. A comparison of computed and observed values of zenith brightness shows good agreement. The presented theory of light scattering in a spherical atmosphere is rather approximate, but it can be made more precise by taking into account a term neglected in one of the formulas or by using an integral equation describing diffusion of radiation in a spherical atmosphere derived earlier by the authors (Astron. zh., 40, No. 3, 496, 1963). The radiation transport equation used does not take into account the refraction of radiation. However, refraction apparently must be taken into account only in a study of first-order scattering for angles ψ close to $\pi/2$. In a study of higher-order scattering refraction probably can be

ACCESSION NR: AP4043498

neglected, as it is neglected in the ordinary theory of light scattering in planetary atmospheres. "The authors wish to thank Ye. B. Babkova and L. P. Savitskaya for computations involved in this study. Orig. art. has 48 formulas and 4 tables.

ASSOCIATION: none

SUBMITTED: 31Jan64 ENCL: 00

SUB CODE: AA, OP NO REF SOV: 007 OTHER: 001

Card 3/3

APPROVED FOR RELEASE: 08/25/2000 CIA-RDP86-00513R001651830003-4"

L 33594-66 EWT(m)/EWP(t)/ETI IJP(c) JD/RDW

ACC NR: AR6016201 SOURCE CODE: UR/0058/65/000/011/D035/D035

61

B

AUTHOR: Sobolev, V. V.

TITLE: Experimental investigations of the energy band structure of crystals of group $A^{II}-B^{VI}$, selenium, tellurium, and group PbS

21

SOURCE: Ref. zh. Fizika, Abs. 11D268

REF SOURCE: Tr. Komis. po spektroskopii. AN SSSR, t. 3, vyp. 1, 1964, 478-486

TOPIC TAGS: energy band structure, selenium, tellurium, lead compound, optic property

ABSTRACT: The optical properties of single crystals of the $A^{II}B^{VI}$ were investigated in the region of 1 - 6 ev. On the basis of the data obtained and those already known, as well as the theoretical calculations of the energy band structure of the crystals, models of the band structures of the crystals under consideration are proposed. [Translation of abstract]

SUB CODE: 20

Card 1/1 92

S/0033/64/041/001/0097/0103

ACCESSION NR: AP4017619

AUTHOR: Sobolev, V. V.

TITLE: An investigation of the atmosphere of Venus. I.

SOURCE: Astronomicheskiy zhurnal, v. 41, no. 1, 1964, 97-103

TOPIC TAGS: Venus, Venus atmosphere, planet, luster curve, atmosphere light scattering

ABSTRACT: The article initiates a series of studies on the atmosphere of Venus. From the planet's luster curve, the values for x (γ) and λ are found using the latest advances in the theory of light scattering. The expressions for these values are derived and the quantities h (α) and g (α) are substituted. The light scattering directrix x (γ) was found to protrude noticeably, suggesting that light scattering is due to large particles in the atmosphere. Sources of possible inaccuracies include: measuring the planet's brightness when the scattering angles are small; assuming that atmospheric strata are planoparallel although their curvature may show up when the phase angles are large; and assuming an atmosphere pattern in which x (γ) and λ are constant although actually these quantities vary with the altitude. More accurate measurement of the optical properties of the atmosphere requires finer observations and further theoretical efforts.

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ACCESSION NR: AP4017619

"The author would like to thank M. L. Zvonareva for performing the calculations." Orig. art. has: 4 tables and 24 formulas.

ASSOCIATION: LENINGRADSKIY GOSUDARSTVENNY*Y UNIVERSITET (Leningrad State University)

SUBMITTED: 27Jun63 DATE ACQ: 18Mar64 ENCL: 00

SUB CODE: AA NO REF SOV: 005 OTHER: 005

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S/0020/64/155/002/0316/0319

ACCESSION NR: AP4022714

AUTHOR: Sobolev, V. V. (Corresponding member)

TITLE: Radiation diffusion in a plane layer of a large optical thickness

SOURCE: AN SSSR. Doklady*, v. 155, no. 2, 1964, 316-319

TOPIC TAGS: radiation diffusion, radiative transfer, large optical thickness layer, plane layer radiation diffusion, semi infinite medium, radiation diffusion, radiation

ABSTRACT: The author discussed in previous publications (DAN, v. 120, no. 1, 1958; v. 116, no. 1, 1957) the radiation diffusion in a semi-infinite medium, and in a plane layer of finite optical thickness τ_0. Now assume that $\tau \gg 1$, the asymptotic solutions are sought for the quantity characteristic of the radiation field in the layer. The integral equation for the radiation diffusion in the layer is solved, and two special cases considered in debate: when the true absorption in the layer is high, and when it is small. Asymptotic solutions for the Ambartsumyan-Chandrasekhar functions are found. "The author is grateful to V. V. Ivanov for a useful discussion." Orig. art. has: 00 figures, 36 equations.

Card 1/2

ACCESSION NR: AP4022714

ASSOCIATION: Leningradskiy gosudarstvenny*y universitet im. A. A. Zhdanova (Leningrad State University).

SUBMITTED: 19Nov63 DATE ACQ: 08Apr64 ENCL: 00

SUB CODE: PH NO REF SOV: 007 OTHER: 001

Card 2/2

BOBOIEV, V.V.

Diffusion of radiation in nebulae of large optical thickness. Trudy Astrofiz. inst. AN Kazakh. SSR 5:285-291 '65. (MIRA 18:6)

L 38215-66 EWT(1) GW/GD

ACC NR: AT6024379 SOURCE CODE: UR/0000/66/000/000/0105/0126

53

B+1

AUTHOR: Sobolev, V. V.

ORG: none

TITLE: Diffuse radiation in a gas

SOURCE: Teoriya zvezdnykh spektrov (Theory of stellar spectra). Moscow, Izd-vo Nauka, 1966, 105-126

TOPIC TAGS: diffuse radiation, interstellar space, stellar atmosphere, radiation dispersion, absorption coefficient, emission coefficient, integral equation, thermodynamic equilibrium

ABSTRACT: The theory of diffuse radiation in planetary nebulae, interstellar space, and stellar and planetary atmospheres deals with processes of radiation dispersion in elementary volumes. Denoting the coefficients of radiation absorption and emission on the frequency ν from a spectral line with σ_ν and ε_ν, these coefficients can be determined by the integral equations

$$\sigma_\nu = nk_0 \frac{a}{\pi} \int_{-\infty}^{+\infty} \frac{e^{-y^2} dy}{(x+y)^2 + a^2},$$

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ACC NR: AT6024379

where

$$x = \frac{\nu - \nu_0}{\Delta\nu_D}, \quad a = \frac{\Delta\nu_E}{\Delta\nu_D};$$

$\Delta\nu_E$ and $\Delta\nu_D$ are the natural and Doppler width of the line, k_0 is the absorption coefficient for one atom in the line's center when a = 0, and n is the number of absorbing atoms in one cm^3. The formula of the absorption coefficient becomes complicated when the Stark effect and collisions are taken into consideration. The emission coefficient is determined by the equation

$$\varepsilon_\nu = \lambda\sigma_\nu \int I_\nu \frac{d\omega}{4\pi} + \varepsilon_\nu^0,$$

where λ is the probability of reemission of the quantum from the line after its absorption; ε_ν^0 is the coefficient of true emission; I_ν is the intensity of emission, and ω is a solid angle. The problem of diffuse radiation can be solved using the equation for radiation transfer along the ray direction. The equation is transformed and adapted to coherent and incoherent cases. In stellar atmospheres absorption and emission occur not only in individual lines, but also in the continuous spectrum where a local thermodynamic equilibrium occurs. The equation system for diffuse radiation may be solved approximately and in exact form

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ACC NR: AT6024379

using computers. The main functions of the equation system are computed for various cases and are given in tabular form. Orig. art. has: 72 formulas. [EG]

SUB CODE: 03/ SUBM DATE: 17Mar66/ ORIG REF: 015/ OTH REF: 024

ATD PRESS: 5044

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L 38214-66 EWT(1) GW/GD

ACC NR: AT6024380 SOURCE CODE: UR/0000/66/000/000/0193/0200

54
BH

AUTHOR: Sobolev, V. V.

ORG: none

TITLE: Models of stellar atmospheres

SOURCE: Teoriya zvezdnykh spektrov (Theory of stellar spectra). Moscow, Izd-vo Nauka, 1966, 193-200

TOPIC TAGS: stellar atmosphere, effective temperature, gravity acceleration, thermodynamic equilibrium, chemical compound, radiation flux, absorption coefficient

ABSTRACT: A model of stellar atmosphere can be computed when the effective temperature and the gravity acceleration are known. The effective temperature can be determined from the measured brightness and the radius of the star and the gravity acceleration from the mass, using corresponding formulas. The model of the stellar atmosphere depends upon many unknown physical conditions in the star. The computation therefore can be carried out using arbitrary assumptions. The usual assumptions are that: the stellar atmosphere is thin compared with its radius; the energy source is located within the star and the radiation energy passes only the atmosphere; a thermodynamic equilibrium with the

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ACC NR: AT6024380

temperature exists in the atmosphere; the chemical composition of the atmosphere is considered to be constant; and the absorption of radiative energy occurs in the range of the continuous spectrum. The radiation flux in the atmosphere is considered to be equal to σT_e^4, where σ is the Boltzmann constant and T_e is the effective temperature. These arbitrary conditions make the computed result problematic. Formulas developed for solution of the problem are transformed introducing real conditions and looking for their accurate solution. A stellar atmospheric model can be solved with high accuracy when the absorption coefficient does not depend upon the frequency. The accuracy of the model depends upon the ratio $\Delta H/H$ where H is the intensity of the radiation flux and ΔH its change from one atmospheric layer to another. This ratio is associated with the absorption coefficient, which is a complicated function of the frequency, temperature, and the chemical compound. Orig. art. has: 25 formulas. [EG]

SUB CODE: 03/ SUBM DATE: 17Mar66/ ATD PRESS: 5044

Card 2/2

L 06254-67 EWT(m)/EWP(t)/ETI IJP(c) JD/JG
ACC NR: AP6031958 SOURCE CODE: UR/0051/66/021/003/0322/0324

42
34
B

AUTHOR: Kovtunenko, S. I.; Sobolev, V. V.

ORG: none

TITLE: Reflection spectra of Ge, InSb, GaSb, InAs and GaP

SOURCE: Optika i spektroskopiya, v. 21, no. 3, 1966, 322-324

TOPIC TAGS: reflection spectrum, germanium single crystal, indium compound, gallium compound, antimonide, arsenide, phosphide, semiconductor crystal

ABSTRACT: The report deals with the reflection spectra in the range of 1-6 eV of Ge and InSb dendrites, specular spalls of GaSb and InAs, and GaP wafers obtained by transport reactions. All the specimens had perfect specular surfaces 2 x 4 mm^2 in area and impurities in the amount of the order of 10^{16} cm^{-3}. The data obtained were compared with earlier data and led to the following conclusions. In etched crystals, the intensity of the shortwave component of the observed doublet is always much lower than that of the longwave component, whereas in dendrites and spalls the intensities of both components of the doublet are approximately equal, and the doublet maximum is much more distinct than in etched samples. In the latter as well as in polished and etched crystals, the relative intensity distribution between the maxima may change from one sample to the next, but the position of the maxima in the spectrum remains unchanged. New findings made in the study include the observation of reflection peaks

UDC: 535.312:535.33:548.0

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ACC NR: AP6031958

8

of 1.44 eV (InSb), 1.68 and 1.38 eV (InAs) and 4.77 eV (GaP), and a more accurate determination (as compared to etched or polished crystals) of the spin-orbital splitting of the valence band at point L. The 1.44 eV (InSb), 1.68 and 1.38 eV (InAs) peaks are attributed to $L_{3'}-L_1$ transitions, and the 4.77 and 3.76 eV (GaP) peaks, to $\Gamma_{15v}-\Gamma_{15c}$ and $L_{3'}-L_1$ or $\Lambda_3-\Lambda_1$ transitions. Authors are deeply grateful to V. N. Maslov, N. M. Demenkov, S. V. Tsivinskiy, M. Ya. Dashevskiy, I. I. Burdiyan, N. I. Luzhnaya, A. I. Koppel' and A. Ya. Nashel'skiy for providing the specimens. Orig. art. has: 3 figures and 1 table.

SUB CODE: 20/ SUBM DATE: 15Jan66/ ORIG REF: 003/ OTH REF: 008

Card 2/2 egk

S/058/62/000/005/047/119
A001/A101

AUTHORS: Gross, Ye. F., Sobolev, V. V.

TITLE: Investigation of the structure of absorption, emission and photoelectric effect at the edge of CdSe crystal fundamental absorption (Theses)

PERIODICAL: Referativnyy zhurnal, Fizika, no. 5, 1962, 33, abstract 5V227 (V sb. "Fotoelektr. i optich. yavleniya v poluprovodnikakh", Kiyev, AN USSR, 1959, 40-42)

TEXT: A fine structure is discovered at low temperatures, most complicated at 4.2°K, in absorption and emission spectra of CdSe single crystals, as well as in the spectral distribution of internal photoeffect. Absorption and emission spectra are strongly polarized. Position of lines and bands in absorption and emission spectra is constant for specimens being in free state, but varies very strongly in dependence upon strains and stresses in the specimen. Conclusions are drawn on the observed bands in CdSe absorption spectra.

[Abstracter's note: Complete translation]

Card 1/1

GROSS, Ye.F.; SOBOLEV, V.V.

Fine structure of the main absorption edge of cadmium selenide single crystals. Fiz. tver. tela 2 no.3:406-413 Mar '60.
(MIRA 14:8)

1. Fiziko-tekhnicheskiy institut AN SSSR, Leningrad.
(Cadmium selenide--Spectra)

81717
S/020/60/133/01/15/070
B014/B011

24.7700

AUTHORS: Gross, Ye. F., Corresponding Member of the AS USSR,
Sobolev, V. V.

TITLE: Photoluminescence Within the Edge of the Fundamental Absorption of Mixed CdSe - CdS Crystals

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 133, No. 1, pp. 56-59

TEXT: In their long introduction the authors discuss the complicated structure of emission and absorption arising at low temperatures in a number of crystals (CdS, CdSe, HgI_2, ZnS, and others) within the longwave absorption edge. In the present paper, the authors study the photoluminescence of macrocrystalline CdSe-CdS solid solutions of CdSe single crystals and of macrocrystalline CdSe- and CdS layers within their absorption edge. The emission and absorption spectra of CdSe single crystals are analyzed in the first chapter. The great analogy with the spectra of CdS single crystals is pointed out. The structure is discussed in greater detail, and, among other things, the great differences existing between

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Photoluminescence Within the Edge of the Fundamental Absorption of Mixed CdSe - CdS Crystals

the bands of different crystals are described. The second chapter treats pure macrocrystalline CdS- and CdSe layers. Agreement is found between the emission and absorption lines of the CdS layers and those of the CdS single crystals. The emission lines of CdS layers at T = 4.2°K exhibit triplet structure, whereas the single crystals have a doublet structure. According to the authors' results, the emission of CdSe layers has a triplet structure. At T = 77.3°K the emission of the CdS layers consists of structureless bands, the CdS single crystals and pure CdSe layers have a doublet structure. The third chapter deals with the macrocrystalline layers of mixed CdSe-CdS crystals. In the case of T = 4.2°K, the photoluminescence of all of the 20 samples under consideration has a structure, and the line spectrum consists of a few weak lines. On heating to 77.3°K, the emission intensity drops, the clearness of the structure and the intensity of the shortwave lines of the edge emission likewise drop sharply, while the intensities of the shortwave components of the doublet and triplet structures rise. There are 3 figures and 18 references: 8 Soviet, 2 French, 3 German, 1 British, and 4 American.

Card 2/3

Some properties of binary semiconducting compounds and generalized moment. M. S. Saidov (10 minutes).

Experimental investigation of the energetic structure of zones of semiconducting compounds. V. V. Sobolev (10 minutes).

Investigation of the thermal conductivity of doped gallium arsenide. M. I. Aliev, G. G. Achmedli.

Concerning the thermal conductivity of solid solutions of Sb_2S_3-Sb_2Se_3.
G. B. Abdulaev, A. A. Bashmaliev.
(Presented by M. I. Aliev--10 minutes).

Report presented at the 3rd National Conference on Semiconductor Compounds, Kishinev, 16-21 Sept 1963

SOBOLEV, V.V.

Possibility of observing Bose-Einstein condensation of excitons in group $A^{II}B^{VI}$ crystals. Fiz. tver. tela 5 no.10:3028-3030 O '63. (MIRA 16:11)

1. Institut fiziki matematiki AN MSSR, Kishinev.

L 41400-65 EEC(b)-2/EWT(1)/EWT(m)/EWG(m)/EWP(b)/T/EWP(t) Pi-4 IJP(c) RDW/GG/JD

ACCESSION NR: AR5009692 UR/0058/65/000/002/D061/D061

SOURCE: Ref. zh. Fizika, Abs. 2D446

34
B

AUTHOR: Sobolev, V. V.

21

TITLE: Emission spectra of coarse-crystal layers of cadmium selenide and sulfide and of mixed CdSe-CdS crystals at T = 77K

18 27

CITED SOURCE: Izv. AN MoldSSR. Ser. yestestv. i tekhn. n., no. 7, 1963, 15-22

TOPIC TAGS: emission spectrum, polycrystal, cadmium selenide, cadmium sulfide, solid solution, absorption edge

TRANSLATION: The edge luminescence spactra of coarse-crystal solid solutions of CdSe-CdS with seven compositions (25:1, 5:1, 3:1, 1:1, 1:2, 1:5, 1:25) and of coarse-crystal CdS and CdSe layers obtained by sputtering the substance on substrates were investigated at 77K. The observed spectra of the CdS and CdSe layers are similar to the emission spectra of the corresponding single crystals in the region of the absorption edge. Shorter-wavelength narrow spectral lines are due to the emission of free and bound excitons; a series of broad equidistant bands

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L 41400-65
ACCESSION NR: AR5009692

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is credited to defects. In the spectra of the mixed CdS-CdSe crystals there is observed a structureless broad band adjacent to the principal absorption edge. The position of this band shifts monotonically with change in composition. The lack of structure is attributed to the presence of a large number of faults that distort the level scheme in the crystal.

SUB CODE: OP, SS ENCL: 00

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Card 2/2

L 18901-63 EWP(q)/EWT(m)/BDS AFFTC RDW/JD

ACCESSION NR: AP3006589 S/0020/63/151/006/1308/1310

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54

AUTHOR: Sobolev, V. V.

TITLE: Experimental study of the band structure of hexagonal crystals of selenium and tellurium [Presented by Academician B. P. Konstantinov, 29 March 1963]

SOURCE: AN SSSR. Doklady*, v. 151, no. 6, 1963, 1308-1310

TOPIC TAGS: Se, Te, dichroism, crystal band structure, reflection spectrum, crystal structure, crystallography, tellurium, selenium

ABSTRACT: Because of the similarity of the crystal structure of Se and Te, the latter have a similar anisotropy of optical, electrical and other properties. Some references attribute the dichroism of the edge-absorption to the doublet conductivity band, others to the valency band. There are other discrepancies in interpretations of the observed phenomena. Therefore, the author has investigated some optical properties of Se and Te crystals. The reflection spectra were studied in the range from 1 to 6 ev. On the basis of these studies, X-ray absorption data, as well as theoritical computations,

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L 18901-63

ACCESSION NR: AP3006589

a scheme of the bands and the transition is suggested. Orig. art. has: 4 figures.

ASSOCIATION: Institut fiziki i matematiki Akademii Nauk MSSR (Institute of physics and mathematics, Academy of Sciences, MSSR)

SUBMITTED: 21Mar63 DATE ACQ: 27Sep63 ENCL: 00

SUB CODE: Ph, El NO REF SOV: 007 OTHER: 010

Card 2/2

SOBOLEV, V.V.

Complex structure of bands and excitons in cadmium selenide crystals. Dokl. AN SSSR 152 no.6:1342-1345 O '63. (MIRA 16:11)

1. Institut fiziki i matematiki AN Moldavskoy SSR. Predstavleno akademikom A.N. Tereninym.

ACCESSION NR: AP4019858 S/0181/64/006/003/0906/0910

AUTHOR: Sobolev, V. V.

TITLE: Complex structure in the valence band of crystals in the group $A^{II}B^{VI}$

SOURCE: Fizika tverdogo tela, v. 6, no. 3, 1964, 906-910

TOPIC TAGS: semiconductor band structure, spin orbital splitting, crystal lattice deformation, Brillouin zone, light absorption

ABSTRACT: The author has sought to find the valid explanation of structure in the upper valence band of the investigated crystals, which consists of three subordinant bands. Two schemes have been proposed for the origin of these bands: that of Birman, in which the upper two bands are due chiefly to spin-orbital splitting and the third to the crystalline field, and that of Hopfield, in which the upper two valence bands are due chiefly to the crystalline field, and the third to spin-orbital splitting. The author follows the lead of G. Ye. Pikus (ZhETF, 5, 1507, 1961) that during deformation the upper two valence bands in hexagonal crystals may shift downward relative to the lower conduction band either similarly

ACCESSION NR: AP4019858

(the Birman scheme) or dissimilarly (the Hopfield scheme), and he examines absorption and reflection spectra in the region of fundamental absorption to discover which view is correct. The position of the upper valence bands and of the exciton lines of the first two exciton series in crystals of CdSe and CdS, after deformation, indicates a markedly different displacement of the upper two valence bands, thus confirming Hopfield's view and contradicting Birman's conclusion. Discovery of ultraviolet absorption bands with triplet structure in CdSe and CdTe, along with the known absorption band in CdS, leads the author to conclude that these bands may be due to transitions: 1) between the three upper valence bands and the conduction band not in the center of the Brillouin zone, 2) between the fourth valence band and the conduction band, or 3) between the valence bands and the conduction band beyond the lowermost band. Data are insufficient to permit proper selection of the best possibility. "In conclusion, I thank G. Ye. Pikus for valuable discussions and for making it possible to acquaint myself with his computations before their publication." Orig. art. has: 2 figures and 2 tables.

ASSOCIATION: Institut fiziki i matematiki AN Mold. SSR, Kishinev (Institute of Physics and Mathematics AN Mold. SSR)

ACCESSION NR: AP4019858

SUBMITTED: 22Mar63 DATE ACQ: 31Mar64 ENCL: 00

SUB CODE: OP, SS NO REF SOV: 006 OTHER: 012

Card 3/3

S/0051/64/016/001/0076/0084

ACCESSION NR: AP 4011487

AUTHOR: Sobolev, V.V.

TITLE: Exciton structure of cadmium selenide crystals

SOURCE: Optika i spektroskopiya, v.16, no.1, 1964, 76-84

TOPIC TAGS: fundamental absorption, absorption spectrum, exciton, exciton states, free exciton, trapped exciton, cadmium selenide, cadmium sulfide, zinc oxide, wurtzite

ABSTRACT: In a series of pervious experimental studies (V.V.Sobolev,Avtoreferat kand.diss.,L,1962; E.F.Gross,V.V.Sobolev,ZhTF 26,1622,1956; FTT,2,406,1960) there were obtained the absorption spectra of cadmium selenide single crystals. Measurement at 4.2°K using a high dispersion (6 Å/mm) spectrograph and thin freely mounted single crystals enabled the experimenters to record the fine structure in the region of the long wavelength edge of the fundamental absorption. The absorption spectra of CdSe crystals were also recorded at 77.3, 160 and 290°K, for the most part using single crystal plates 0.1 microns thick. The absorption lines at 4.2°K, which fall into three major groups, are tabulated. Two spectrograms are reproduced. On the

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ACC.NR: AP4011487

basis of the polarization behavior the continuous and line "edge" absorption of CdSe may be divided into two parts. In the present paper the earlier experimental results are summarized, and discussed and analyzed from the standpoint of the exciton mechanism. The general conclusions arrived at on the basis of analysis of the lines detected in the region of the fundamental absorption edge are the following: 1) All the absorption lines are very narrow; hence all three types of exciton states are associated with non-localized excited states of the CdSe lattice. 2) All three types of non-localized (free) excitons have the same energy level structure: the energy gaps between the levels of one exciton are virtually repeated in the energy structure of the other two types of excitons. 3) The long wavelength and short wavelength subgroups of lines in each of the three exciton groups can be associated with the first and second excited states of the excitons, respectively. Some of the distinctive features of cadmium selenide crystals as compared with other wurtzite type crystals of the same class are discussed. "I thank E.F.Gross for his interest in the work." Orig.art.has: 3 formulas, 2 figures and 2 tables.

L 21732-65 EWT(l)/EWG(k)/T/EWA(h) Peb/Pz-6 IJP(c)/SSD(c)/ASD(a)-5/SSD/ AFMD(t)/AFETR/ESD(c)/ESD(gs) AT

ACCESSION NR: AP4043391 S/0181/64/006/008/2537/2539

AUTHOR: Sobolev, V. V.; Sy*rbu, N. N.

TITLE: Band structure of gallium phosphide

SOURCE: Fizika tverdogo tela, v. 6, no. 8, 1964, 2537-2539

TOPIC TAGS: gallium compound, band spectrum, doublet splitting, conduction band, valence band, reflected radiation spectrum

ABSTRACT: The reflection spectrum of GaP at 290K had two peaks at 230 and 330 mμ, the latter a doublet consisting of lines at 320 and 335 mμ. The doublet peak at 3.7 ev corresponded to direct interband transitions at the point L and the reflection peak at 5.4 ev corresponded to the point X, which can be seen in the energy band structure of GaP derived in the present paper (see Fig. 1 of Enclosure). F. Herman's formula (J. Electronics, v. 1, 103, 1955) was used to calculate the energies of direct interband transitions and the separa-

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L 21732-65
ACCESSION NR: AP4043391

tion of the uppermost valence band from the second conduction band at the point Γ. The conclusions of Gross et al. (FTT, v. 3, 3543, 1961) on the valence band structure of GaP are stated to be incorrect. Orig. art. has: 2 figures.

ASSOCIATION: Institut fiziki i matematiki AN Mold. SSR, Kishinev (Institute of Physics and Mathematics, AN MoldSSR)

SUBMITTED: 23Jan64 ENCL: 01

SUB CODE: IC, OP NO REF SOV: 003 OTHER: 006

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L 21732-65

ACCESSION NR: AP4043391 ENCLOSURE: 01

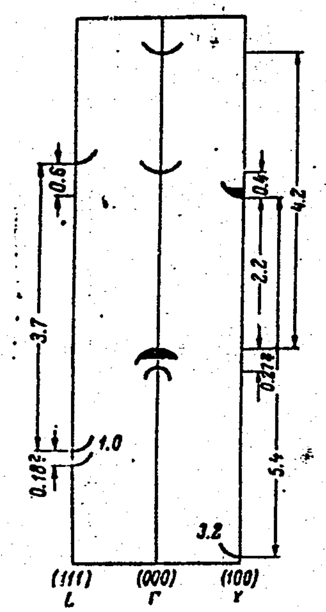

Fig. 1

Energy band structure of gallium phosphide

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ACCESSION NR: AP4043392 S/0181/64/006/008/2539/2541

AUTHORS: Sobolev, V. V.; Andriyesh, A. M.; Sy*rbu, N. N. Shumov, S. D.

TITLE: Reflection spectra of crystals of groups II-IV and III-VI

SOURCE: Fizika tverdogo tela, v. 6, no. 8, 1964, 2539-2541

TOPIC TAGS: indium antimonide, cadmium alloy, group II element, group III element, group IV element, group VI element, reflected radiation spectrum, band spectrum

ABSTRACT: This investigation was undertaken in connection with the great interest which is attached to compounds of the CdSb and In_2Te_3 type. The energy structure of crystals of groups II--V and III--VI was investigated at 290K in the region 1--6 eV. The reflection spectra of polished and etched crystals CdSb, ZnSb, 56% ZnSb-44% CdSb, Cd_4Sb_3, Zn_3Sb_2, Zn_4Sb_3, In_2Se_3, In_2Te_3, $CdIn_2Se_4$, Ga_2Se_3, Ga_2Te_3,

ACCESSION NR: AP4043392

GaSe, and GaTe were investigated. The similarities and differences between the various spectra are briefly discussed. It is concluded that in view of the similarity of their reflection spectra, the crystals CdSb, ZnSb, and Zn_3Sb_2, Zn_4Sb_3, and Cd_4Sb_3 have similar energy-band structures and nearly equal transition energies. The general conclusion is that the compounds of groups II--V and III--VI are close to compounds of groups III--V and II--VI not only in lattice structure but also in the type of bond and energy-band structure. Orig. art. has: 1 figure.

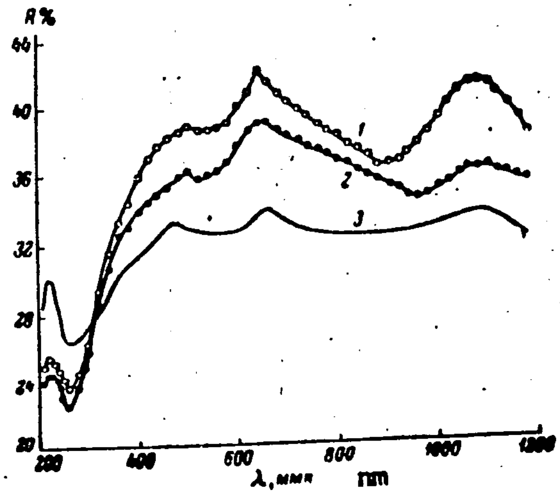
ASSOCIATION: Institut fiziki i matematiki AN MoldSSR, Kishinev (Institute of Physics and Mathematics, AN MoldSSR)

SUBMITTED: 23Jan64 ENCL: 01

SUB CODE: SS NR REF SOV: 003 OTHER: 001

Card 2/3

ACCESSION NR: AP4043392 ENCLOSURE: 01



Reflection spectra at T = 290°K in the range of 1-6 eV; 1 - ZnSb, 2 - CdSb, 3 - In_2Te_3

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L 11085-65 EWT(l)/EWT(m)/T/EWP(t)/EEC(b)-2/EWP(b) IJP(c)/SSD/ASD(a)-5/ ESD(gs)/ESD(t) JD

ACCESSION NR: AP4046631 S/0181/64/006/010/3124/3130

AUTHOR: Sobolev, V. V.

TITLE: Energy band structure of crystals of groups IV and III-V

SOURCE: Fizika tverdogo tela, v. 6, no. 10, 1964, 3124-3130

TOPIC TAGS: group IV element, group III alloy, group V alloy, reflected radiation spectrum, energy band structure, optic crystal

ABSTRACT: The authors investigated the reflection spectra of single crystals of Si, Ge, InP, InAs, InSb, GaP, GaAs, and GaSb at 290K in the range 1--6 eV. The results yielded a larger number of reflection peaks than were previously obtained by the author and by others. The band structure of the compounds of groups III--V is found to be very close to the band structure of crystals of group IV, particularly germanium. The structures of the reflection spectra of the crystals are explained on the basis of a scheme for direct

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L 11085-65
ACCESSION NR: AP4046631

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interband transitions at points L, X, and Γ, which were defined by the author in his dissertation (State Optical Institute, Leningrad, 1962). In addition, the spin-orbit splitting of the valence bands at the points and L and of the transitions at the points Γ, L, and X are determined. An arrangement is proposed for the location of the extrema of the bands at the points L, X, and Γ. The results are compared with experiment and with calculations by others, and some of the discrepancies are explained. Orig. art. has: 3 figures, 1 formula, and 2 tables.

ASSOCIATION: Institut fiziki i matematiki AN MoldSSR, Kishinev (Institute of Physics and Mathematics, AN MoldSSR)

SUBMITTED: 23Jan64 ENCL: 00

SUB CODE: SS, OP NR REF SOV: 007 OTHER: 022

Card 2/2

L 38479-66 EWT(1)/EWT(m)/T/EWP(t)/ETI IJP(c) AT/RDW
ACC NR: AR6017244 SOURCE CODE: UR/0058/65/000/012/D039/D039

AUTHOR: Sobolev, V. V.

TITLE: Quantitative studies of exciton absorption in single crystals of cuprous oxide, cadmium selenide, cadmium sulfide, and lead dioxide

SOURCE: Ref. zh. Fizika, Abs. 12D326

REF SOURCE: Tr. Komis. po spektroskopii. AN SSSR, t. 3, vyp. 1, 1964, 487-494

TOPIC TAGS: exciton absorption, spectral distribution, crystal absorption, absorption coefficient

ABSTRACT: The spectral distribution of the exciton absorption coefficient was obtained by the study of crystal absorption at low temperatures. The contours of the lines were determined and the oscillator strengths were computed. The theoretical and experimental data were compared. [Translation of abstract] [KP]

SUB CODE: 20/ SUBM DATE: none/

Card 1/1 pb

S/0048/64/028/006/1090/1095

ACCESSION NR: AP4041384

AUTHOR: Sobolev, V.V.

TITLE: Optical investigations of the energy structure of bands in some crystals /Report, Third Conference on Semiconductor Compounds held in Kishinev 16-21 Sep 1963]

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v.28, no.6, 1964, 1090-1095

TOPIC TAGS: reflected radiation spectrum, conduction band, silicon, germanium, indium compound, gallium compound

ABSTRACT: The author has obtained the optical reflection spectra of crystalline Si, Ge and the six compounds of the type $A^{III}B^{V}$ in which A is In or Ga and B is P, As or Sb. The Si and Ge spectra were in good agreement with those of H.R.Phillip and E.A.Taft (Phys.Rev.113,1002,1959; 120,37,1960) except for the Ge reflection peak at 3.35 eV, which was found to be much sharper than reported by Phillip and Taft. The reflection spectra of the compounds were all very similar; each had one intense sharp peak between 200 and 400 millimicrons and a broad less intense maximum between 400 and 800 millimicrons. The longer wavelength peak was absent in GaP and double in GaSb and GaAs. These spectra are compared with results obtained by seve-

ACCESSION NR: AP4041384

ral other workers. There is much agreement among the results of the different experimentors, but there is also considerable disagreement; further experiments to clarify this situation are now under way. The spectra are compared with calculated band structures and the features are tentatively identified. It is found that the X_4-X_1 (X_5-X_1) and $L_{3'}-L_1$ separations are approximately the same (2 to 2.2 eV) in all the compounds investigated, and it is tentatively concluded that the lower conduction band in crystals of the A^{IV} and $A^{III}B^{V}$ types shift by the same amount at the L and X points. Earlier optical measurements on CdSe by the author and Ye.F.Gross are reviewed briefly. These data, together with experimental data on ZnSe, CdS, ZnS and ZnO from various sources are compared with theoretical band structures. It is concluded that the band scheme of J.J.Hopfild (J.Phys.Chem.Solids 10,1597,1960) is correct for the sulfides and selenides, and that of J.L.Birman (Phys.Rev.114,1490,1959) for ZnO. "The author is deeply grateful to S.M.Ry*vkin, D.N.Nasledov, N.A.Gorynova, B.T.Kolomiyts and V.M.Tuchkevich for kindly providing the crystals." Orig.art.has: 3 figures and 2 tables.

ASSOCIATION: Institut fiziki i matematiki Akademii nauk MoldSSR (Institute of Physics and Mathematics, Academy of Sciences, MoldSSR)

SUBMITTED: 00

ENCL: 00

SUB CODE: OP,SS

NR REF SOV: 012

OTHER: 021

Card 2/2

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Optical [illegible] of the [illegible] of the bands of [illegible]
[illegible] Izv. [illegible] Ser. fiz. 28 no.6:[illegible] Je '64.
(MIRA [illegible])

1. [illegible] AN Moldavskoy SSR.

APPROVED FOR RELEASE: 08/25/2000 CIA-RDP86-00513R001651830003-4"

L 5017-66 EWT(m)/EWP(t)/EWP(b) IJP(c) JD

ACC NR: AP5026322 UR/0368/65/003/004/0372/0374
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B

AUTHOR: Sobolev, V. V.

TITLE: Energy structure of aluminum antimonide zones

SOURCE: Zhurnal prikladnoy spektroskopii, v. 3, no. 4, 1965, 372-374

TOPIC TAGS: crystal surface, crystal optic property, crystal lattice energy, light reflection coefficient, spectrum analysis, aluminum, antimonide

ABSTRACT: The recent intensive development of the theoretical structure of the energy zones of crystals in the k-space and the establishment of a direct connection between the reflection spectra in the E~Eg region and the structure of the zones led to a successful investigation of crystal reflection spectra in the domain of self-absorption. The least studied of the III-V group of compounds seem to be the AlSb crystal. An energy level diagram for the AlSb crystal zones (shown in Fig. 1) has been proposed elsewhere. To check these theoretical predictions the present author carried out reflection spectrum determinations shown in Fig. 2 in good agreement with the energy level diagram. Numerous studies of the influence of surface conditions on the crystal reflection spectra of Si, Ge, GaAs, GaSb, GaP, InAs, InSb, and InP indicate that the position of the maxima does not change in spite of possible large variations in the shape of the curves. "The author thanks M. S. Mirgalovskaya, and I. A. Strel'nikova for kindly supplying the AlSb monocrystals, S. G. Kroitor for carrying out the measurements, and M. Cardona and

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